Assessment of Groundwater Quality by Physico-Chemical Parameters in Konduga, Borno State, North-Eastern Nigeria

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Abstract **-** Assessment of groundwater quality studies was carried out in the agrarian town of Konduga, Borno state, North-eastern Nigeria, to find the suitability of groundwater for drinking and domestic purposes. Due to the limited water sources, a total of six groundwater samples were collected randomly from bore wells and open wells. The test was conducted for physico-chemical parameters such as pH, alkalinity, acidity, hardness, chloride, nitrates, nitrites, phosphate and potassium. Comparison with WHO standards in relation to drinking water quality. It proved that most of the water samples were found within limits of standards but there is the need for grave caution to be observed in the pollution trend.

Keyword - physico-chemical parameters, groundwater, domestic.

I. INTRODUCTION

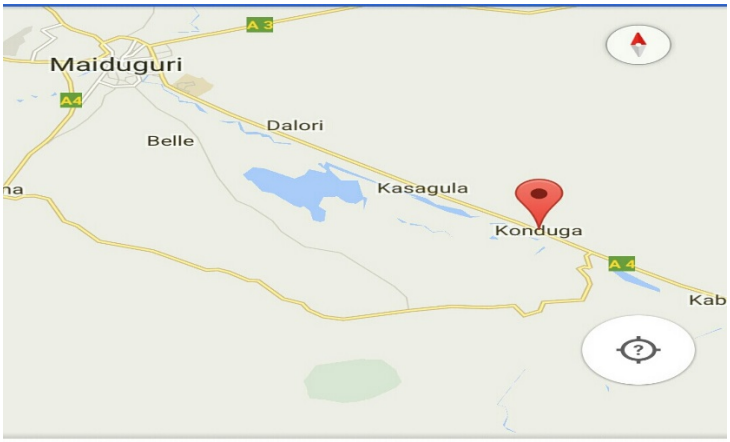
Quality drinking water is essential for life. Unfortunately, in many countries around the world, including Nigeria, water has become a scarce commodity [1] as only a small proportion of the populace has access to treated water. Alternative sources of water such as rainwater and ground water have become major sources of drinking water for people living in new settlements and some residents who do not have access to treated water in northern Nigeria. The need to assess the quality of water from some of these alternative sources has become imperative because they have a direct effect on the health of individuals. [2] Water is necessary to life on earth. All organisms contain it, some live in it, some drink it. Plants and animals require water that is moderately pure and cannot survive if the water is polluted with some chemicals or harmful microorganism. Fish and shell fish harvested from polluted waters may be unsafe to eat. People who ingest polluted water can become ill, and with prolonged exposure may develop cancer or children with birth defect. It is estimated by the world health organization (W.H.O) that about 58% of all sicknesses and diseases in the world is associated with unsafe water supply, sanitation and hygiene [3] e.g. cholera, typhoid. Apart from the social benefits associated with controlling the quality of water. There are also economic gains. Very hard water or water containing harmful substance can cause corrosion. These effects are eliminated by treating the water and will be of great benefit to any society. Water is the most important, abundant and useful natural resources on the earth because no life is possible without water. It is essential for the survival of all living beings and plays an important role in our life. But unfortunately the water quality is influenced by the natural and anthropogenic activities including environmental stress particularly pollution such as domestic, agriculture, industrial, hydropower etc. The natural water analyses for physical and chemical properties including trace element contents are very important for public health studies. [4] These studies are also a main part of pollution studies in the environment. For years, history has shown that the farmers engaged in local farming before accepting and getting aware of the use of fertilizers and some chemicals to improve their farm yield. With increase in population and demand for food, farming activities in the area has become a bit mechanized, and the application of chemical fertilizer and other toxic chemical (pesticides, herbicides) in large quantities to improve the quality and productivity of crop has increased.[5] The use of fertilizer and these chemical is now being extended to a great extent where almost all the arable land are constantly sprayed with these chemical in an attempt to meet the requirement of the nation's economy. Some of these chemical are biodegradable and quickly decay into harmless or non-toxic forms while others are non-biodegradable chemicals such as chlordane and dichloro diphenyl trilchloroethene (DDT), these chemicals are absorbed into the tissues or organs of the animals. When other animals feed on these contaminated animals the chemicals are passed up the food chain with each step up the food chain, the concentration of the pollutant increases. In one study, DDT level in ospreys (a family of fish eating birds) were found to be 10 to 50 times higher than in the fish that they ate.[6] Therefore scientific study needs to review strategies for conservation and better utilization of groundwater. So this

project examines the physico-chemical parameters of the ground water as it relates to chemical fertilizer.

II. MATERIALS AND METHOD

The sample well divided into two categories; category A which cover two sample wells inside farmland and category B which cover four sample well located away from the irrigation area each sample well is within a concentric circle of 8km. All samples will be taken from each of these wells making a total of six samples and each and every sample will be tested for about eight parameters

III. BACKGROUND OF THE STUDY AREA



The research area (KONDUGA LOCAL GOVERNMENT) is one of (27) local governments of Borno state covered with arable land, irrigation channels to feed up the crops with water when the season is dry. The konduga community is the center of a local government area of the same name about 25km to the southeast of Maiduguri. Situated on the north bank of river Ngadda, the population of konduga local government area is about 157,322 at the 2006 census. Most inhabitants are illiterate and are engaged in subsistence farming, most people did not have access to portable drinking water. [7]

The water sample from the hand pumps were collected in plastic bottles. After the collection of samples, these bottles were labelled and possible efforts made to transport them to the laboratory as earlier as possible. The samples were chemically analyzed for various water quality parameters such pH, total alkalinity, acidity, total hardness, phosphate, potassium, nitrate, nitrite and chloride using standard procedures. The methods used for estimation of various physico-chemical parameters are tabulated in Table 1.

TABLE 1. Methods used for estimation of physico-chemical parameters.

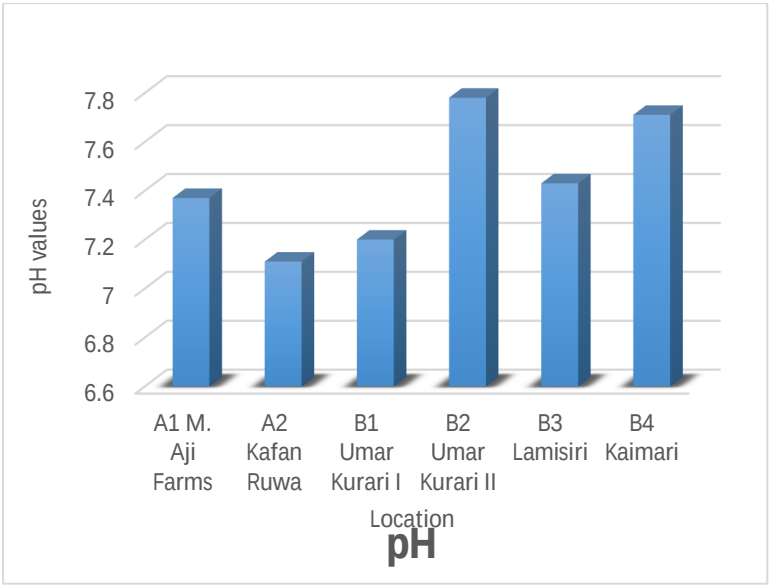
S. No.	Parameter	Methods
1	pH	pH meter
2	Hardness	C200 multi parameter ion specific meter
3	Acidity	Phenolphthalein Indicator method
4	Alkalinity	Indicator method
5	Chloride	Silver nitrate method
6	Nitrate	C200 multi parameter ion specific meter
7	Nitrite	C200 multi parameter ion specific meter
8	Phosphate	Spectrophotometer
9	Potassium	atomic absorption spectrophotometer

IV. RESULTS AND DISCUSSION

In studied areas the groundwater was free from odor and color. The physico-chemical characteristics of water sample analyzed have been presented in Table 2.

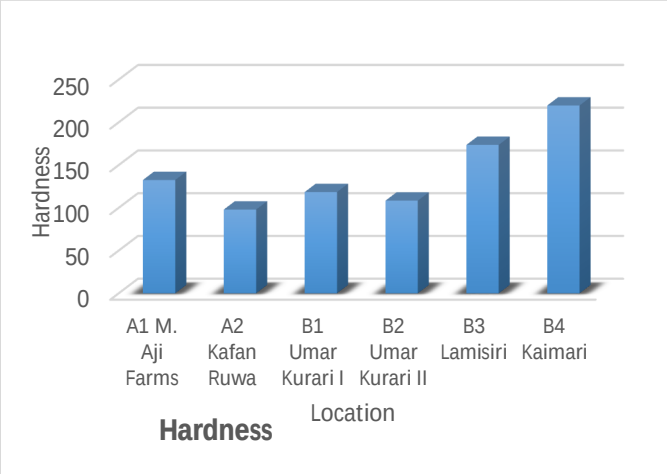
pH

The pH being the measure of acidity and alkalinity of a given sample. For category A (sample well located inside farms) is within the permissible limit of WHO standard. Also for category B (sample well located away from farm) is also slightly basic this is above the highest desirable level and within the range of the minimum permissible level provided by WHO. pH is an important parameter which determines the suitability of water for various purposes.



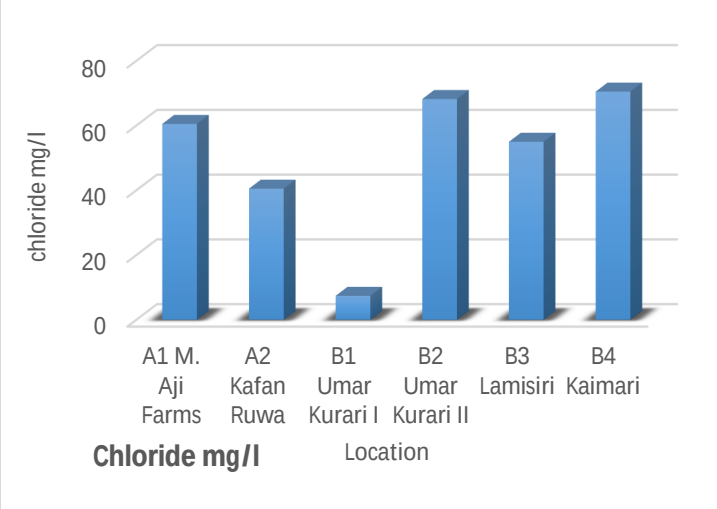
HARDNES

Hard water are generally undesirable for aesthetic and economic reason [8]. This is because it makes water unpalatably objectionable and interferes with industrial processes. For that reason WHO sets 500mg/l on the maximum permissible limit for portable water. For the six sample tested, three of the hardness of $CaCO_3$ are within the lowest desirable limit while three of the remaining sample are above the minimum desirable limit but within the maximum permissible limit.



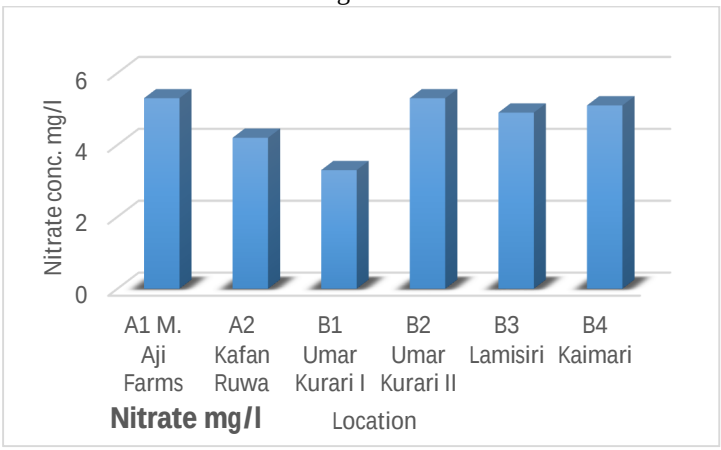
CHLORIDE

The average value of chloride obtained from category A is 80.53 mg/l while that in category B is 66.03 mg/l which are below the highest desirable level provided by both WHO and Nigerian standard of water quality. This shows that the water contained some amount of micro-organisms because chloride is used as disinfectant to kill micro-organisms that are present in water.



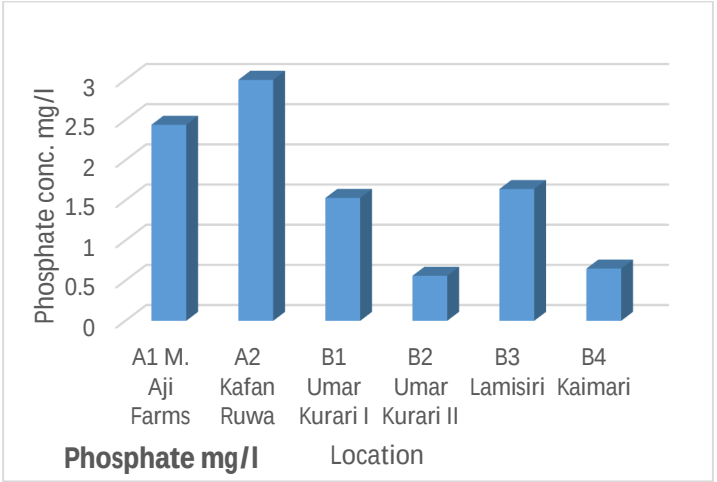
NITRATES AND NITRITES

The observed substantial amount of nitrites is within the safe limits for the analyzed sample A and B. since the movement of water in the wells is limited to aquifer gradient, thus there is time enough for the denitrification to occur in bottom of wells. This action may account for the concentration of nitrates in some wells. Nitrates and nitrites may also leach from in-situ sanitation units as in case of category B, improper landfills and from waste water disposal. Presence of nitrates in category A, is due to intensive agricultural activities that is excessive application of chemical fertilizer and local ground water movements.



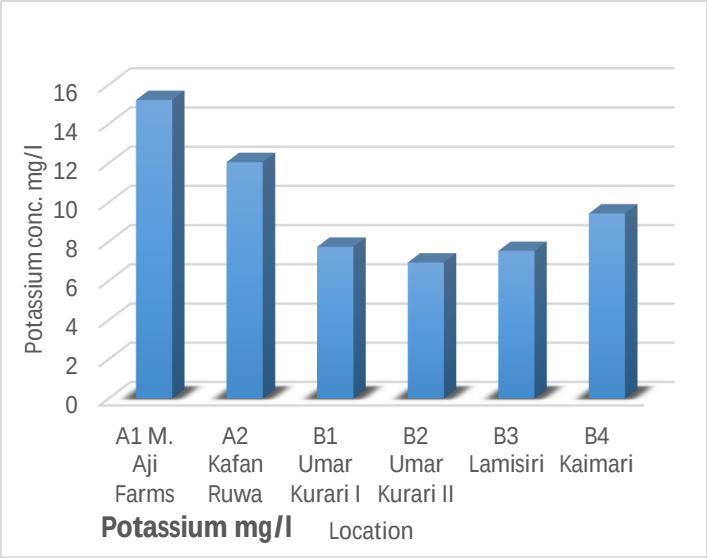
PHOSPHATES

The values of phosphate obtained from the sample well located inside the farm are higher but are within the maximum permissible limit. This shows that presence of phosphate in ground water increase with agricultural activities. While for the sample located away from farmland the values are relatively less.



POTASSIUM

Potassium is an essential element for man, plants and animals. The value of potassium obtained for category A sample well inside farm is within the value provided by the standards. Category B is also within the value provided by WHO and Nigerian standards.



It was observed that agricultural practices slightly affected the quality of ground water due to intensive application of fertilizer in the study area. Also chemicals used to kill unwanted plants (weeds) and animals in the farm or sub-urban yards that are collected by rain water (run-off or through infiltration) into the ground water may in the nearest time, if not checked, grossly affect the groundwater quality in the study are:

TABLE 2

SAMPLES	A1	A2	B1	B2	B3	B4	WHO	NIS
Site condition	Bore hole	Open well	Bore hole	Open well	Open well	Open well		
Season	Dry	Dry	Dry	Dry	Dry	Dry		
PH	7.37	7.11	7.20	7.78	7.43	7.71	7.8-9.2	6.5-8.5
Alkalinity (mg/l)	132.6	98.0	118.45	108.4	173.6	219.7	500	100
Hardness (mg/l)	42	72	81	330	210	576	100-500	150
Chlorides (mg/l)	60.53	40.5	7.41	68.21	55.00	70.48	91-250	250
Nitrite (mg/l)	0.00	0.00	0.00	0.00	0.00	0.00		0.2
Nitrate (mg/l)	5.3	4.2	3.3	5.3	4.9	5.1	50	50

V. CONCLUSION

Important chemical parameter that are determined in the ground water of the study area shows that the water inside contains a little higher values of contaminants, while the water far away from the farm is more chemically free based on the analysis. Furthermore, considering the high application of chemical fertilizer in the study area, it thus indicate the large amount of phosphate, potassium and chloride affects the quality of ground water inside the farm which is quite different outside the farm. Finally by compare the two categories A and B, category A, sample wells inside the farm is having higher values of the chemical parameters while category B sample wells away from the farm shows lesser values. Thus, the study is within safe limits provided by WHO [9] and the Nigerian Industrial Standard (NIS) [10]. However, the pollution trend must be checked so that it cannot escalate in the nearest time.

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